Intestinal kinetics from digestion of milk proteins in humans

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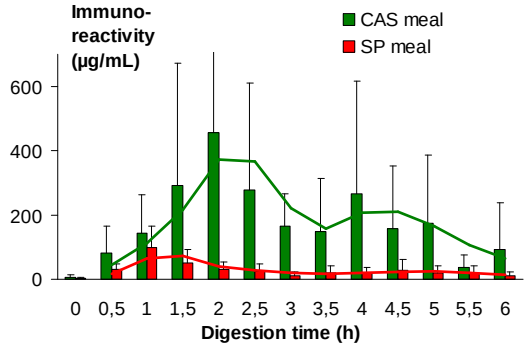
Introduction. Which peptides are released through the digestion of milk proteins? To answer this question, many *in vitro* studies aimed to determine the kinetics of digestion and to investigate the release of a given peptide. Both these aims have also been achieved in few studies realized *in vivo* in animals (rat and minipigs). The scare studies in humans concerned either the peptides recovered in stomach or duodenum or have been performed in human volunteers with an ileostomy (Mahé et al. 1991, Meisel et al. 2003).

Objective. We aim to assess in humans the intestinal digestion of two protein fractions from milk, i.e. a soluble (SP) and non-soluble (casein; CAS) proteins, that exhibit opposite chemical and digestive characteristics.

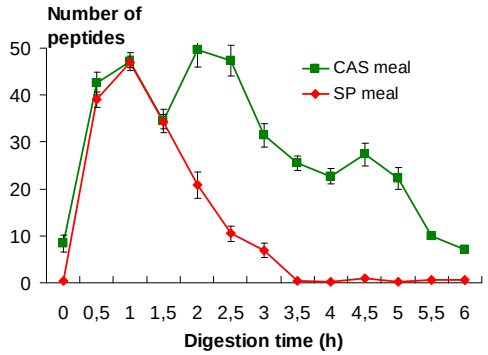
Methods. This study has been performed on 14 volunteers whose protein intake was constituted of 30 g of either casein (n=7) or SP (n= 6). Jejunal effluents were continuously collected for 6 hours using a double lumen nasogastric tube. Both the kinetics and the patterns of peptides reaching the gut were determined: immunoreactive proteins were quantified and peptides were analysed using mass spectrometry.

Results



Large protein fragments are present thus demonstrating that proteins digestion was incomplete in the jejunum.

Immunoreactive proteins are composed of intact proteins as well as large and small peptides that contain the immunoreactive region. For both meals, the kinetics and the amount of immunoreactive proteins in the jejunum vary largely from one volunteer to another. In addition both parameters differ in CAS meal compared to SP one.



Peptides appear continuously in jejunum after CAS meal.

About 50 different peptides are identified in the ileal effluents from 0.5 to 2.5 hours digestion of caseins, and about 30 until 5 hours of digestion. About 50 different peptides are identified from 0.5 to 1.5 hours digestion for SP meal; this number greatly decreases thereafter.

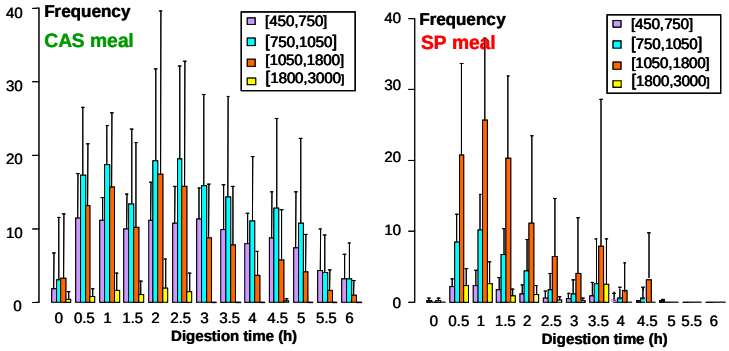
The kinetics differ for the two meals.

Immunoreactive proteins and peptides are present in a greater amount during the first hour of digestion for SP meal whereas a two-step digestion is observed for CAS meal: a first one at 1.5-2.5 hours and a second one 4-5 hours after meal ingestion.

The peptides derived from casein meal are smaller than the ones from SP meal.

For the casein meal, the 750-1050 Da peptides are the most frequently observed throughout the digestion time. With respect to SP digestion, the 1050-1800 Da peptides are in larger amount.

Common peptides are identified in ileal effluents from volunteers who ingested the same meal. For example 31 common peptides from β-casein are identified from 0.5 to 5 hours digestion and among them 14 peptides are identified in all the volunteers. Among these common peptides, some are bioactive peptides.



Conclusion. The rate of peptide appearance in the jejunum has not been estimated previously in humans. Under the conditions of this study, i.e. a single protein meal, we demonstrated that large protein fragments were present within the jejunum and that two dietary protein fractions have different metabolic fates. The digestion of caseins and soluble proteins differed in both the intestinal kinetics and the molecular weight of the peptides in the jejunum.

The differential intestinal digestion kinetics of milk proteins offers a number of applications, especially in overweight and elderly people or in patients with wasting disorders.